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SUBJECT: Some Design Considerations for a
Console to Evaluate the Visual
Sampling Behavior of the Astronauts
During Long Duration Flights-
Case 710

DATE: June 12, 1969

FROM: M. A. Robinson

ABSTRACT

A preliminary design concept for a console to evaluate the visual sampling behavior of the astronauts is presented.

The main feature of the design is the use of pivoting and telescoping arms with instrument heads mounted at the ends. This feature makes it possible to obtain a variety of display configurations as well as to adjust the distance of the instruments in accordance with the visual field of each astronaut.

(NASA-CR-106882) SOME DESIGN CONSIDERATIONS
FOR A CONSOLE TO EVALUATE THE VISUAL
SAMPLING BEHAVIOR OF THE ASTRONAUTS DURING
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MEMORANDUM FOR FILE

I. INTRODUCTION

In a recent memorandum (Ref. 1), the author reviewed the latest research in the visual sampling behavior of pilots and astronauts, and concluded that this aspect of vision could be used as an indicator of stress, and hence as a method of anticipating performance degradation during long duration flights.

Visual sampling behavior, namely, rapid eye movements across multi-instrument displays, can be recorded by reflecting low intensity infra-red light from the eyes into photoelectric sensors. This type of instrumentation, which is described in greater detail in the previous memorandum, requires that the head of the pilot or astronaut be held stationary with respect to the display. More advanced eye tracking apparatus is under development which may make it possible to record eye positions without restraining the head, but this has not been accomplished to date.

The purpose of this memorandum is to present a preliminary design concept for a console to evaluate the visual sampling of the astronauts, and to discuss some of the factors that should be taken into consideration in developing this equipment.

II. DESCRIPTION OF THE CONSOLE

A. The Telescoping Arms

A concept for the visual sampling console is given in Figures 1 and 2. Four telescoping arms are shown with instrument heads. It should be noted that these instruments are not exact duplicates of those found in aircraft or spacecraft cockpits, although there may be circumstances under which we may wish to approximate the actual instruments more closely. The task of the subject is to scan the four instruments, looking for a variety of signals such as:

1. Individual instrument readings above or below a certain value.
2. Individual instrument readings changing (at various rates) toward particular thresholds.
3. Two or more instruments with readings in the categories above.

The telescoping arms serve several purposes. They provide a convenient means of conserving space when the visual sampling apparatus is not being used. They permit various configurations of the instruments, such as a rectangle, semi-circle, etc.; it should be noted here that the arms would pivot and that the instrument heads also pivot about the end of the arms so that the instruments can be oriented towards the horizontal.

Finally, and of particular importance, is the fact that the length of the arms can be altered in accordance with the "field of view" of each individual. With the head held stationary, each person can comfortably see out to certain angles in given directions. These angles differ for each individual, and, once determined for each astronaut, can be used to position the instrument heads for the visual sampling experiments to be conducted in space.

For purposes of research on the ground, the console will be mounted on the pedestal and the wires running through the telescoping arms can be maintained at a slight tension by means of pulleys and weights. The space version of the console, which will be mounted in a rack, can use spring tensioned reels to keep the wires from tangling when the telescoping arms are moved in or out.

B. The Instrument Heads

As mentioned above, the concept envisions digital instrument heads. If desired, these can be replaced by analog instrument heads. Digital displays have the advantage of requiring a minimum of interface equipment between the instruments and a digital computer which will serve to control the visual sampling experiments.

C. The Response Mechanism

In actual flight, a pilot or astronaut scans his cockpit instruments and controls his vehicle. This controlling behavior may be either discrete or continuous, as exemplified by setting a switch or moving a joystick, respectively. The latter is generally characterized as "tracking" behavior, and is considered as a separate measurement for assessing astronaut performance during long duration flights. Therefore, responses should be employed that do not involve tracking, but rather identifying relevant information in one or more of the instruments, and pressing the correct button or lever in a hand held response mechanism.

In earlier apparatus for studying visual sampling behavior, Senders (Ref. 2) used a single button on a hand held response mechanism to indicate that the subject had discovered significant information in one of the instruments. It was assumed that the subject's response to this information would be correct, and the experiment was confined to an analysis of his ability to pick up the necessary information within the time allowed.

In using the apparatus suggested here, it may be desirable to provide for a somewhat more elaborate response range by having several levers to press which correspond to operational alternatives such as Normal Mode, Emergency Mode, etc. It should be noted that by providing response alternatives, the study is no longer confined to visual sampling behavior but includes the option of analyzing selective responses to the information acquired by the astronaut.

III. OTHER CONSIDERATIONS

As noted above, the eye movement recording equipment available to date requires that the head be held stationary with respect to the display. The most precise way of positioning the head is by means of a "bite plate", which consists of a plastic mouthpiece which is smooth on the bottom but conforms to the upper set of teeth. This mouthpiece is fastened to a bar which in turn fits into a slot in the visual sampling apparatus (not shown in the figures). In use, the individual maintains a slight pressure on the bite plate, thus positioning the head at a precise distance from the apparatus.

IV. CONCLUSIONS AND RECOMMENDATIONS

One of the concepts presently under study by NASA is the use of an Integrated Medical and Biological Laboratory System (IMBLMS) which would contain a set of medical and behavioral experiments for the analysis of the condition of the astronauts during long duration flights. Although several tests of astronaut vision are planned, visual sampling behavior is mentioned only in passing. One of the reasons for glossing over this vital aspect of vision is, in the authors opinion, the hitherto unsolved problem of developing a console for this assessment, which at the same time, could fit into the limited space assigned to each of the IMBLMS experiments. A space-conserving design for such a console is presented here.

In addition, the author recommends that the ground based research and verification of this approach should not be tied exclusively to the IMBLMS program, but that the existing program of research in visual sampling behavior sponsored by Langley Research Center (R. T. Saucer, Contract Monitor) be expanded to include console development, and both ground and flight studies.

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1. Robinson, M. A., "A Method for Assessing Astronaut Performance Capabilities During Long Duration Flights, Case 630", Washington D. C. Bellcomm, Inc., Memorandum for File, Jan. 13, 1969.
2. Senders, J. W., J. I. Elkind, M. C. Grignetti and R. Smallwood. "An Investigation of the Visual Sampling Behavior of Human Observers", Washington, D. C., NASA Contractor Report, CR-434, April, 1966.

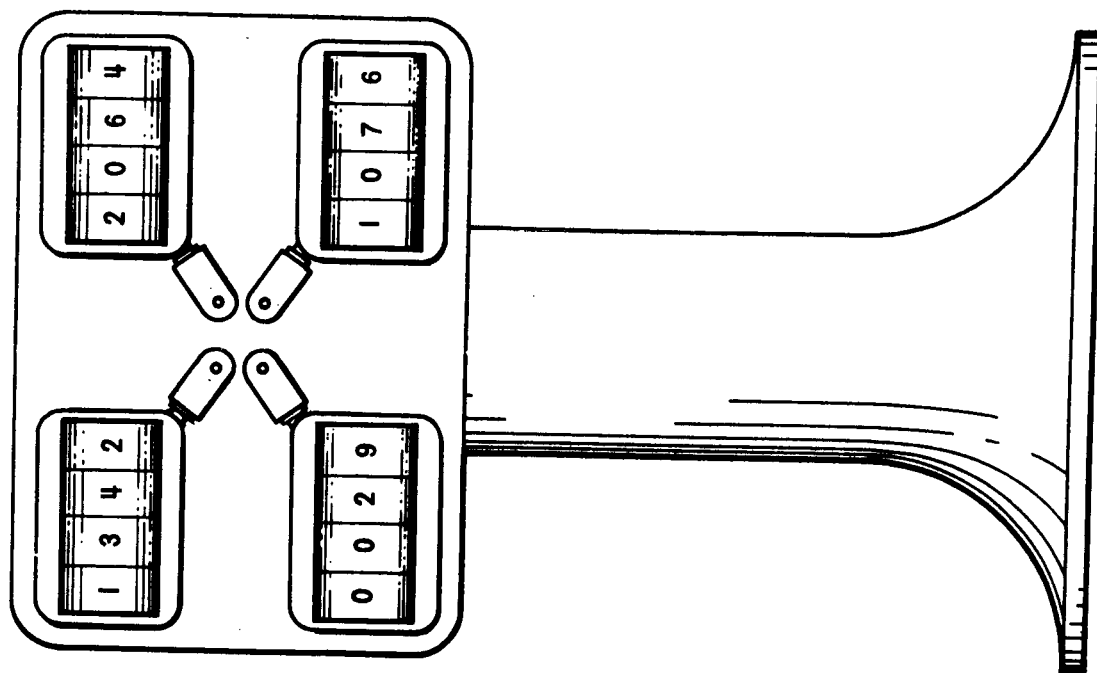


FIGURE 1 - VISUAL SAMPLING APPARATUS
WITH DISPLAYS RETRACTED

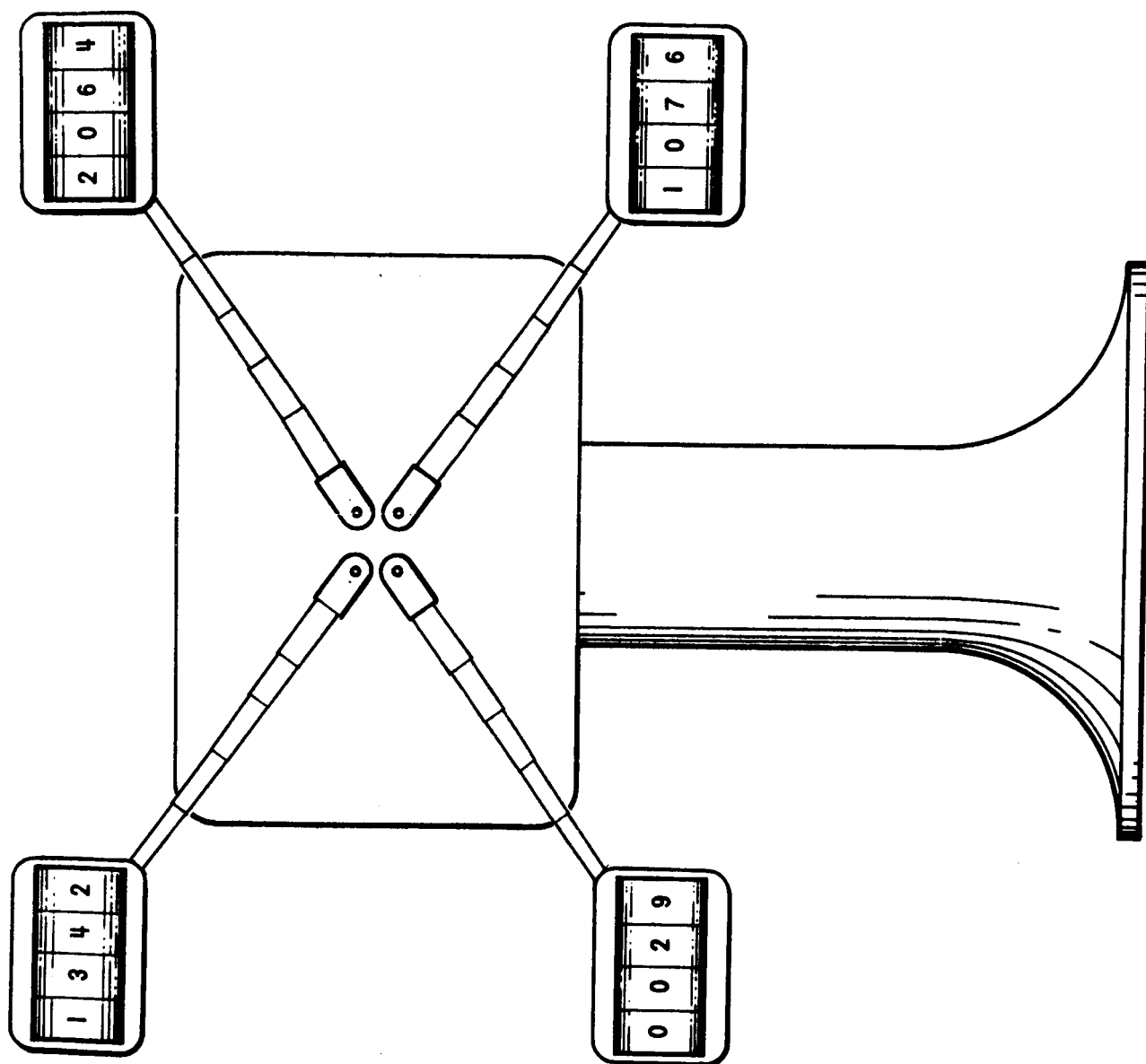


FIGURE 2 - VISUAL SAMPLING APPARATUS
WITH DISPLAYS EXTENDED

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